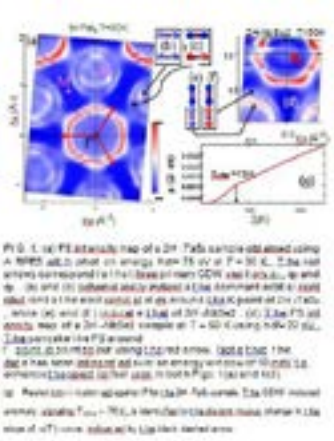
Utpal Chatterjee, J Material Sci Eng 2017, 6:7 (Suppl)
DOI: 10.4172/2169-0022-C1-079

Universal and system-specific charge density wave features in 2H-transition metal dichalcogenides

Utpal Chatterjee
University of Virginia, USA

Recently, the studies of incommensurate charge density wave (CDW) phases in various 2H-polytypes of transition metal dichalcogenides (TMDs), e.g., 2H-$NbSe_2$ and 2H-$TaSe_2$, have attracted a lot of attention due to intriguing experimental observations, some of which are reminiscent of the enigmatic pseudogap phase in cuprate high temperature superconductors (HTSCs). We present a comprehensive Angle Resolved Photoemission spectroscopy. ARPES) study on 2H-TaS_2, a canonical incommensurate CDW material. Comparing our ARPES data together with arguments based on a tight-binding analysis on 2H-TaS_2, with those on related materials like 2H-$NbSe_2$ and 2H-$TaSe_2$, we identify the generic and system-specific characteristics of these systems. We find the following generic features of incommensurate CDW TMDs: (i) opening of CDW energy gap (Δ_{cdw}) along part of the underlying Fermi Surface (FS) sheets; (ii) finite Δ_{cdw} at temperatures above the CDW transition temperatures and particle-hole asymmetry in Δcdw and a lack of one-to-one correspondence between CDW wave vectors and the FS nesting vectors. We have also observed some system-specific features. For example, in contrast to 2H-$NbSe_2$, where Δ_{cdw} is non-zero only at a few "hot spots" on a specific FS sheet, Δ_{cdw} in 2H-TaS_2 is non-zero along the entirety of multiple FS sheets. Using a tight-binding model, we describe this in terms of the difference in the orbital orientations of their electronic states close to the Fermi level. In short, our strong-coupling model can describe both the generic and the material-specific features of these compounds. Therefore, we argue that the strong electron-phonon coupling, including its orbital and momentum-dependence, is key to the incommensurate CDW instability in TMDs.



Biography

Utpal Chatterjee has completed his PhD from University of Illinois at Chicago in 2007. Afterwards, he has conducted his Postdoctoral studies at Matreials Science Division of Argonne National Laboratory with Director's fellowship. He has joined University of Virginia in 2012. His research is focused on experimental study of strongly correlated electronic systems. His principal expertise in angle resolved photoemission spectroscopy. His research over past 10 years has produced many high impact publications, which include Nat. Commun, 2015; 6: 6313 DOI: 10.1038/ncomms 7313, Nat. Phys. 10, 357; PNAS 110, 17774; PNAS 108, 9346; Nat. Phys. 6, 99; PRL 96, 107006.

uc5j@eservices.virginia.edu

Notes: